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(54) **ILLUMINATED TOUCH KEYBOARD**

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(52) **U.S. Cl.**
CPC ***H01H 13/83*** (2013.01); *H01H 2219/014* (2013.01); *H01H 2219/06* (2013.01); *H01H 2219/062* (2013.01); *H03K 2217/96046* (2013.01)

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USPC 362/23.03–23.06
See application file for complete search history.

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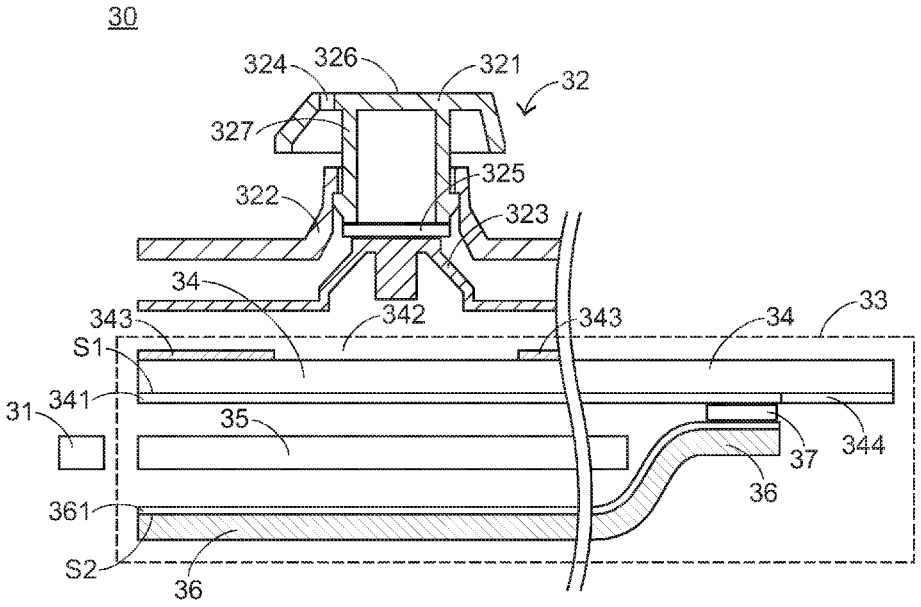
(57) **ABSTRACT**

An illuminated touch keyboard includes a light source, a key structure, and a non-contact sensor board. The non-contact sensor board is used for sensing a depressing action of the key structure. The non-contact sensor board includes a light-shading plate, a light guide plate, and a reflecting plate. The light-shading plate includes a first wiring layer. The reflecting plate includes a second wiring layer. Since the light-shading plate, the light guide plate and the reflecting plate are include in the non-contact sensor board, the fabricating cost of the illuminated touch keyboard is reduced, and the overall height of the illuminated touch keyboard is decreased.

11 Claims, 3 Drawing Sheets



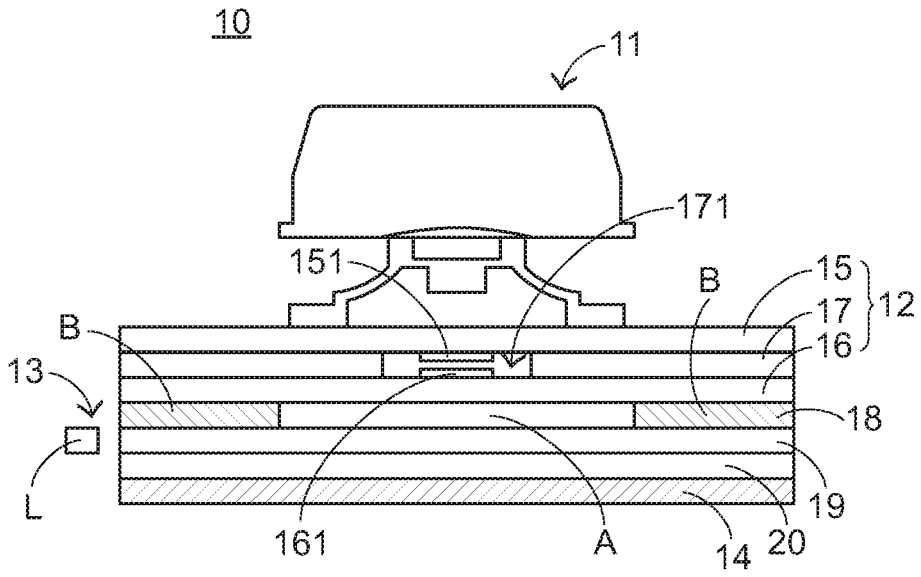


FIG.1
PRIOR ART

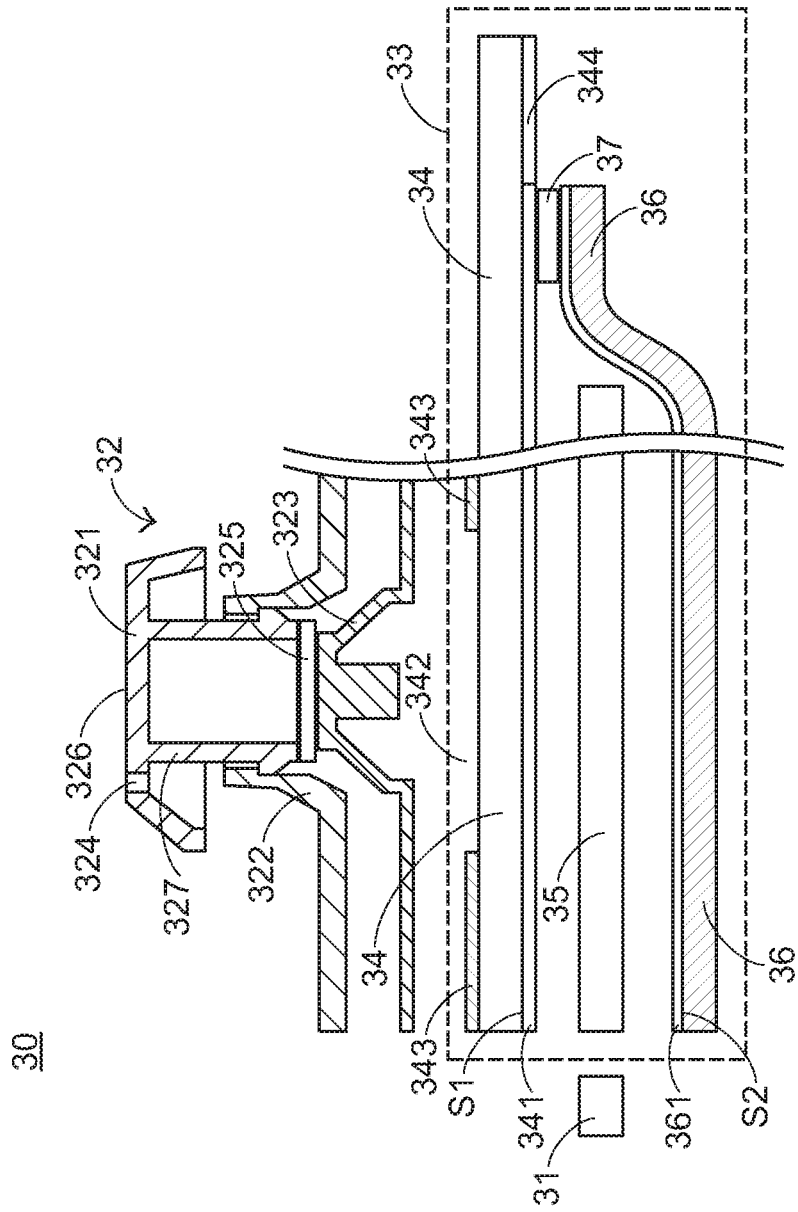

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FIG.2

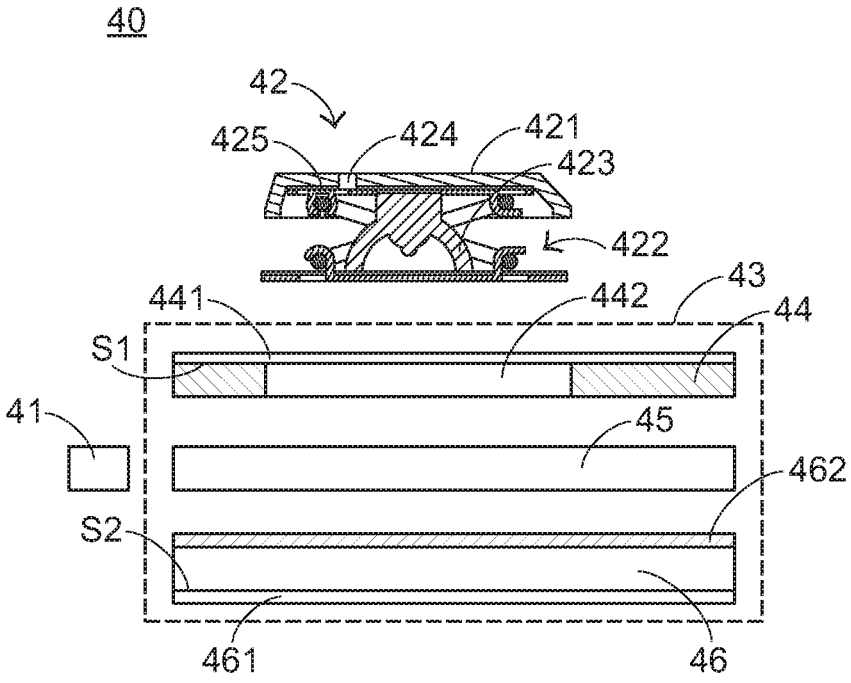

FIG.3

ILLUMINATED TOUCH KEYBOARD

FIELD OF THE INVENTION

The present invention relates to a touch keyboard, and more particularly to an illuminated touch keyboard.

BACKGROUND OF THE INVENTION

For allowing users to operate keyboards in a dark or dim environment, some keyboards with light sources such as light emitting diodes (LED) have been introduced into the market. The light sources may provide light beams to illuminate the keyboards. The keyboards with the illuminating functions are also referred as illuminated keyboards. By using the illuminated keyboards, the users can easily identify the characters or the symbols marked on the keys of the illuminated keyboards.

FIG. **1** is a schematic view illustrating a conventional illuminated keyboard. As shown in FIG. **1**, the conventional illuminated keyboard **10** comprises a key structure **11**, a membrane switch board **12**, a backlight module **13**, and a bottom plate **14**. The membrane switch board **12** comprises an upper wiring plate **15**, a lower wiring plate **16**, and a partition plate **17**. The backlight module **13** comprises a light-shading plate **18**, a light guide plate **19**, a reflecting plate **20**, and a light source L.

The key structure **11** is disposed over the membrane switch board **12** to be depressed by the user. When the key structure **11** is depressed, the membrane switch board **12** is electrically conducted to generate a key signal. The detailed structures of the membrane switch board **12** will be illustrated as follows.

In the membrane switch board **12**, the upper wiring plate **15** comprises an upper circuit layer **151**, and the lower wiring plate **16** comprises a lower circuit layer **161**. The upper circuit layer **151** and the lower circuit layer **161** are circuit patterns that are made of an electrically-conductive material. The upper wiring plate **15** is disposed over the lower wiring plate **16**. The partition plate **17** comprises plural perforations **171**. Moreover, the partition plate **17** is arranged between the upper wiring plate **15** and the lower wiring plate **16** for preventing erroneous contact between the upper wiring plate **15** and the lower wiring plate **16**.

As the key structure **11** is depressed, the upper wiring plate **15** is subjected to deformation. Consequently, the upper circuit layer **151** of the upper wiring plate **15** is penetrated through the corresponding perforation **171** of the partition plate **17**, and the upper circuit layer **151** of the upper wiring plate **15** is contacted with the lower circuit layer **161** of the lower wiring plate **16**. Under this circumstance, the electrical connection between the upper circuit layer **151** and the lower circuit layer **161** results in the key signal.

The backlight module **13** is disposed under the membrane switch board **12** for illuminating the key structure **11**. The backlight module **13** comprises the light-shading plate **18**, the light guide plate **19**, the reflecting plate **20**, and the light source L. The light guide plate **19** is located at a side of the light source L for transferring the light beam, which is emitted by the light source L. The reflecting plate **20** is disposed under the light guide plate **19** for reflecting the light beam to the light guide plate **19**, thereby increasing the light utilization efficacy of the light source L. The light-shading plate **18** is disposed over the light guide plate **19**. Moreover, the light-shading plate **18** comprises a light-transmissible region A and an opaque region B. The light beam is allowed to be transmitted through the light-transmissible region A of the light-shading plate **18**. The opaque region B of the light-shading plate **18** is used for shading the light beam in order to prevent the light beam from being transmitted to any place where the light beam is not needed. Consequently, the light leakage problem can be eliminated. The bottom plate **14** is disposed under the backlight module **13** for supporting the key structure **11**, the membrane switch board **12** and the backlight module **13**.

By means of the light guide plate **19**, the reflecting plate **20** and the light-shading plate **18** of the backlight module **13**, the light beam from the light source L can be uniformly transferred to each key structure **14**. Consequently, the illuminated keyboard **10** has the backlighting function, the number of the light sources L is reduced, and the light leakage from the key structure **11** will be minimized. Under this circumstance, the illuminated keyboard **10** is cost-effective and aesthetically pleasing. However, the conventional illuminated keyboard **10** still has some drawbacks. For example, due to the thicknesses of the light-shading plate **18**, the light guide plate **19** and the reflecting plate **20**, the arrangement of the backlight module **13** under the membrane switch board **12** may increase the overall height of the illuminated keyboard **10**. Consequently, it is difficult to further reduce the thickness of the illuminated keyboard **10**.

Therefore, there is a need of providing an improved illuminated keyboard in order to eliminate the above drawbacks.

SUMMARY OF THE INVENTION

The present invention provides a slim-type illuminated touch keyboard.

In accordance with an aspect of the present invention, there is provided an illuminated touch keyboard. The illuminated touch keyboard includes a light source, a key structure, and a non-contact sensor board. The light source is used for emitting a light beam. When the key structure is depressed, a key signal is correspondingly triggered. The non-contact sensor board is disposed under the key structure for sensing a depressing action of the key structure, thereby generating the key signal. The non-contact sensor board includes a light-shading plate, a light guide plate, and a reflecting plate. The light-shading plate includes a first wiring layer and plural light-transmissible regions. The first wiring layer is formed on a first surface of the light-shading plate, and the light beam is transmissible through the plural light-transmissible regions. The light guide plate is disposed under the light-shading plate for transferring the light beam, which is emitted by the light source. The reflecting plate is disposed under the light guide plate for reflecting the light beam. The reflecting plate includes a second wiring layer, and the second wiring layer is formed on a second surface of the reflecting plate.

The above objects and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating a conventional illuminated keyboard;

FIG. **2** is a schematic view illustrating an illuminated touch keyboard according to a first embodiment of the present invention; and

FIG. **3** is a schematic view illustrating an illuminated touch keyboard according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **2** is a schematic view illustrating an illuminated touch keyboard according to a first embodiment of the present invention. As shown in FIG. **2**, the illuminated touch keyboard **30** comprises a light source **31**, a key structure **32**, a non-contact sensor board **33**, and a conductive adhesive layer **37**.

The light source **31** is located at a side of the non-contact sensor board **33** for emitting a light beam and providing the light beam to the key structure **32**. In this embodiment, the light source **31** comprises one or more light emitting diodes (LED), but is not limited thereto. The key structure **32** is used for triggering a key signal in response to a depressing action. That is, when the key structure **32** is depressed, the key signal is correspondingly triggered. Moreover, the non-contact sensor board **33** is disposed under the key structure **32** for sensing the depressing action of the key structure **32**, thereby generating the key signal.

The key structure **32** may be a plunger key structure, a scissors key structure or any other key structure that is known in the art. In this embodiment, the key structure **32** is a plunger key structure. The key structure **32** comprises a keycap **321**, a key base **322**, an elastic element **323**, a light-outputting part **324**, and a conductive element **325**. The keycap **321** comprises a pressing part **326** and a plunger part **327**.

The pressing part **326** is disposed on a top surface of the keycap **321** to be depressed by the user. The plunger part **327** is connected with the pressing part **326**. In addition, the plunger part **327** and the pressing part **326** are linked with each other. The plunger part **327** is disposed within the key base **322**, and the plunger part **327** is movable upwardly or downwardly relative to the key base **322**. The elastic element **323** is disposed under the plunger part **327**. Especially, the elastic element **323** is arranged between the plunger part **327** and the non-contact sensor board **33** for providing a restoring force. In response to the restoring force, the keycap **321** is returned to its original position.

The conductive element **325** is located at an end of the plunger part **327**. In this embodiment, the conductive element **325** is a conductive foam structure or a metallic paint film, but is not limited thereto. The light-outputting part **324** is formed on the keycap **321** for outputting the light beam, thereby facilitating the user to identify the key structure **32**. Moreover, the light-outputting part **324** is a light-outputting number region, a light-outputting character region or a light-outputting symbol region. The method of forming the light-outputting part **324** is similar to the method of forming the light-outputting part of the conventional illuminated keyboard, and is not redundantly described herein.

The non-contact sensor board **33** is a touch-sensitive sensor board that is enabled in a non-contact manner without the contact between adjacent circuit layers. For example, the non-contact sensor board **33** is a capacitive sensor board or a magnetic sensor board, which is known in the art. In this embodiment, the non-contact sensor board **33** is a capacitive sensor board, but is not limited thereto.

The non-contact sensor board **33** comprises a light-shading plate **34**, a light guide plate **35**, and a reflecting plate **36**. The light-shading plate **34** is used for shading the light beam in order to prevent the light beam from being transmitted to any place where the light beam is not needed. Consequently, the light leakage problem can be eliminated. The light guide plate **35** is disposed under the light-shading plate **34** and located at a side of the light source **31** for transferring the light beam, which is emitted by the light source **31**. The reflecting plate **36** is disposed under the light-shading plate **35** for reflecting the light beam, which is emitted by the light source **31**.

The light-shading plate **34** comprises a first wiring layer **341**, plural light-transmissible regions **342**, a light-shading ink layer **343**, and a pin **344**. The reflecting plate **36** comprises a second wiring layer **361**. The light-shading ink layer **343** is disposed on the light-shading plate **34** for shading the light beam. The plural light-transmissible regions **342** are formed in the light-shading plate **34**. The light beam is transmissible through the plural light-transmissible regions **342**, and directed to the key structure **32**.

The first wiring layer **341** is formed on a first surface S1 of the light-shading plate **34**. The second wiring layer **361** is formed on a second surface S2 of the reflecting plate **36**. The pin **344** is disposed on the light-shading plate **34**, but is not limited thereto. The pin **344** is electrically connected with the first wiring layer **341** and the second wiring layer **361**. Moreover, the pin **344** electrically connected with a power source (not shown), and the key signal is outputted from the pin **344**.

Moreover, the first surface S1 of the light-shading plate **34** may be a top surface or a bottom surface of the light-shading plate **34**, and the second surface S2 of the reflecting plate **36** may be a top surface or a bottom surface of the reflecting plate **36**. In this embodiment, the first wiring layer **341** is formed on the bottom surface of the light-shading plate **34**, and the second wiring layer **361** is formed on the top surface of the reflecting plate **36**. In addition, the first wiring layer **341** and the second wiring layer **361** are electrically connected with each other through the conductive adhesive layer **37**.

The conductive adhesive layer **37** is arranged between the light-shading plate **34** and the light guide plate **35**. In this embodiment, the conductive adhesive layer **37** is located at a side of the light-shading plate **34** and a side of the light guide plate **35**. The position of the conductive adhesive layer **37** is presented herein for purpose of illustration and description only. Alternatively, in some other embodiments, the conductive adhesive layer **37** may be located at any position between the light-shading plate **34** and the light guide plate **35**. An example of the conductive adhesive layer **37** includes but is not limited to an anisotropic conductive film (ACF) or an anisotropic conductive paste (ACP).

The first wiring layer **341** and the second wiring layer **361** may be electrically connected to electrodes with opposite polarities, respectively. For example, the first wiring layer **341** is electrically connected to a positive electrode (not shown), and the second wiring layer **361** is electrically connected to a negative electrode (not shown). Moreover, the distribution of the electric field between the first wiring layer **341** and the second wiring layer **361** may result in a coupling capacitance.

The structures and the functions of the light-shading plate **34** are similar to those of the conventional light-shading plate. The light-shading plate **34** will be illustrated in more details as follows. The light-shading plate **34** is a light-transmissible substrate, wherein the light-shading ink layer **343** is partially coated on a top surface or a bottom surface of the light-shading plate **34** for shading the light beam. Since the light beam can be transmitted through the region of the light-shading plate **34** uncovered by the light-shading ink layer **343**, the region of the light-shading plate **34** uncovered by the light-shading ink layer **343** is the light-transmissible region **342** of the light-shading plate **34**.

It is noted that the way of forming the plural light-transmissible regions **342** are not restricted. In some other embodiments, the light-shading plate **34** is a light-transmissible substrate, and the light-shading ink layer **343** is completely coated on a top surface or a bottom surface of the light-

shading plate **34**. For allowing the light beam to be transmitted through the light-shading plate **34** to illuminate the key structure **32**, the light-shading plate **34** comprises plural openings (not shown). The plural openings run through the light-shading plate **34**. Moreover, the plural openings are aligned with the key structure **32**. Since the openings are not covered by the light-shading ink layer **343**, the light beam can be transmitted through the light-shading plate **34**. In other words, the openings of the light-shading plate **34** may be considered as the light-transmissible regions **342** of the light-shading plate **34**.

In an embodiment, the light-transmissible substrate of the light-shading plate **34** is made of a light-transmissible material such as polymethylmethacrylate (PMMA), polycarbonate (PC) or polyethylene terephthalate (PET). Moreover, the light-shading ink layer **343** is made of black ink, but is not limited thereto.

The structures and the functions of the reflecting plate **36** are similar to those of the conventional reflecting plate. The reflecting plate **36** is made of an opaque material. The reflecting plate **36** is used for reflecting the portion of the light beam that is transmitted through the light guide plate **35**. Consequently, the light utilization efficacy of the light source **31** is enhanced.

If the light beam transferred within the light guide plate **35** is shaded by the first wiring layer **341** and the second wiring layer **361**, the luminous efficacy of the illuminated touch keyboard **30** will be deteriorated. For enhancing the luminous efficacy, the electrode patterns of the first wiring layer **341** and the second wiring layer **361** may be made of a transparent conductive material. An example of the transparent conductive material includes but is not limited to indium tin oxide (ITO), nano silver, nano copper, carbon nanotube, or graphene. Moreover, the first wiring layer **341** and the second wiring layer **361** may be formed by a printing process, a spraying process or an electroplating process, but are not limited thereto.

As the pressing part **326** of the key structure **32** is depressed by the user, the key structure **32** is moved toward the non-contact sensor board **33**. Correspondingly, the conductive element **325** at the end of the plunger part **327** is moved to a position near the non-contact sensor board **33**. Under this circumstance, the distribution of the electric field between the first wiring layer **341** and the second wiring layer **361** is changed, and thus a capacitance value between the first wiring layer **341** and the second wiring layer **361** is changed. Due to the change of the capacitance value, the conductive element **325** is sensed by the non-contact sensor board **33**, and a corresponding key signal is generated by the non-contact sensor board **33**. The sensing principles and the coordinate calculating ways of the non-contact sensor board **33** are similar to those of the conventional capacitive sensor board, and are not redundantly described herein.

FIG. **3** is a schematic view illustrating an illuminated touch keyboard according to a second embodiment of the present invention. As shown in FIG. **3**, the illuminated touch keyboard **40** comprises a light source **41**, a key structure **42**, and a non-contact sensor board **43**. The non-contact sensor board **43** comprises a light-shading plate **44**, a light guide plate **45**, and a reflecting plate **46**.

The light source **41** is located at a side of the non-contact sensor board **43** for emitting a light beam and providing the light beam to the key structure **42**. In this embodiment, the light source **41** comprises one or more light emitting diodes (LED), but is not limited thereto. The key structure **42** is used for triggering a key signal in response to a depressing action. That is, when the key structure **42** is depressed, the key signal is correspondingly triggered. Moreover, the non-contact sensor board **43** is disposed under the key structure **42** for sensing the depressing action of the key structure **42**, thereby generating the key signal.

The light-shading plate **44** is used for shading the light beam in order to prevent the light beam from being transmitted to any place where the light beam is not needed. Consequently, the light leakage problem can be eliminated. The light guide plate **45** is disposed under the light-shading plate **44** and located at a side of the light source **41** for transferring the light beam, which is emitted by the light source **31**. The reflecting plate **46** is disposed under the light-shading plate **45** for reflecting the light beam, which is emitted by the light source **41**.

Except for the key structure **42**, the positions of the wiring layers of the non-contact sensor board **43** and the structure of the light-shading plate **44** and reflecting plate **46**, the other components of the illuminated touch keyboard **40** are similar to those of the illuminated touch keyboard of the first embodiment (see FIG. **2**), and are not redundantly described herein.

In the illuminated touch keyboard **40** of the second embodiment, the key structure **42** is a scissors key structure. The key structure **42** comprises a keycap **421**, a scissors-type supporting structure **422**, an elastic element **423**, a light-outputting part **424**, and a conductive element **425**.

The scissors-type supporting structure **422** is disposed under the keycap **421** for supporting the keycap **421**. The elastic element **423** is disposed under the keycap **423**. Especially, the elastic element **423** is arranged between the keycap **421** and the non-contact sensor board **43** for providing a restoring force. In response to the restoring force, the keycap **421** is returned to its original position.

The conductive element **425** is disposed on a bottom surface of the keycap **421**. In this embodiment, the conductive element **425** is a conductive foam structure or a metallic paint film, but is not limited thereto. The light-outputting part **424** is formed on the keycap **421** for outputting the light beam, thereby facilitating the user to identify the key structure **42**. Moreover, the light-outputting part **424** is a light-outputting number region, a light-outputting character region or a light-outputting symbol region. The method of forming the light-outputting part **424** is similar to the method of forming the light-outputting part of the conventional illuminated keyboard, and is not redundantly described herein.

The light-shading plate **44** of the non-contact sensor board **43** comprises a first wiring layer **441** and plural light-transmissible regions **442**. The first wiring layer **441** is formed on a first surface S**1** of the light-shading plate **44**. In this embodiment, the first wiring layer **441** is formed on a top surface of the light-shading plate **44**, and the light-shading plate **44** is made of an opaque material.

For allowing the light beam to be transmitted through the light-shading plate **44** to illuminate the key structure **42**, the light-shading plate **44** further comprises plural openings (not shown). The plural openings run through the light-shading plate **44**. Moreover, the plural openings are aligned with the key structure **42**. Since the light beam can be transmitted through the light-shading plate **44**, the light-shading plate **44** may be considered as the light-transmissible regions **442** of the light-shading plate **44**.

The reflecting plate **46** comprises a second wiring layer **461** and a reflective layer **462**. The second wiring layer **461** is formed on a second surface S**2** of the reflecting plate **46**. In this embodiment, the second wiring layer **461** is formed on a bottom surface of the reflecting plate **46**. Moreover, the second wiring layer **461** is electrically connected with the first wiring layer **441**. The reflective layer **462** is disposed on the

reflecting plate **46** for reflecting the portion of the light beam that is transmitted through the light guide plate **45**. Consequently, the light utilization efficacy of the light source **41** is enhanced. Moreover, the reflective layer **462** may be a white ink layer, but is not limited thereto.

As the keycap **421** of the key structure **42** is depressed by the user, the key structure **42** is moved toward the non-contact sensor board **43**. Correspondingly, the conductive element **425** on the bottom surface of the keycap **421** is moved to a position near the non-contact sensor board **43**. Under this circumstance, the distribution of the electric field between the first wiring layer **441** and the second wiring layer **461** is changed, and thus a capacitance value between the first wiring layer **441** and the second wiring layer **461** is changed. Due to the change of the capacitance value, the conductive element **425** is sensed by the non-contact sensor board **43**, and a corresponding key signal is generated by the non-contact sensor board **43**. The sensing principles and the coordinate calculating ways of the non-contact sensor board **43** are similar to those of the conventional capacitive sensor board, and are not redundantly described herein.

From the above descriptions, the illuminated touch keyboard comprises a light source, a key structure, and a non-contact sensor board. The non-contact sensor board comprises a light-shading plate, a light guide plate, and a reflecting plate. In the non-contact sensor board of the illuminated touch keyboard of the present invention, a first wiring layer and a second wiring layer are formed on the light-shading plate and the reflecting plate, respectively. Consequently, it not necessary to install an additional light-shading plate, an additional light guide plate and an additional reflecting plate over or under the non-contact sensor board. Under this circumstance, the fabricating cost of the illuminated touch keyboard is reduced, and the overall height of the illuminated touch keyboard is decreased.

While the invention has been described in terms of what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention needs not be limited to the disclosed embodiment. On the contrary, it is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

What is claimed is:

1. An illuminated touch keyboard, comprising:

a light source for emitting a light beam;

a key structure, wherein when said key structure is depressed, a key signal is correspondingly triggered; and

a non-contact sensor board disposed under said key structure for sensing a depressing action of said key structure, thereby generating said key signal, wherein said non-contact sensor board comprises:

a light-shading plate comprising a first wiring layer and plural light-transmissible regions, wherein said first wiring layer is formed on a first surface of said light-shading plate, and said light beam is transmissible through said plural light-transmissible regions;

a light guide plate disposed under said light-shading plate for transferring said light beam, which is emitted by said light source;

a reflecting plate disposed under said light guide plate for reflecting said light beam, wherein said reflecting plate comprises a second wiring layer, and said second wiring layer is formed on a second surface of said reflecting plate; and

a pin electrically connected with said first wiring layer of said light-shading plate and said second wiring layer of said reflecting plate.

2. The illuminated touch keyboard according to claim **1**, wherein said non-contact sensor board is a capacitive sensor board.

3. The illuminated touch keyboard according to claim **1**, wherein said first surface of said light-shading plate is a top surface or a bottom surface of said light-shading plate, and said second surface of said reflecting plate is a top surface or a bottom surface of said reflecting plate.

4. The illuminated touch keyboard according to claim **1**, wherein said light-shading plate is a light-transmissible substrate with a light-shading ink layer.

5. The illuminated touch keyboard according to claim **1**, wherein said light-shading plate is made of an opaque material, and said plural light-transmissible regions are openings.

6. The illuminated touch keyboard according to claim **1**, wherein said plural light-transmissible regions are openings.

7. The illuminated touch keyboard according to claim **1**, wherein said reflecting plate is a light-transmissible substrate with a reflective layer.

8. The illuminated touch keyboard according to claim **1**, wherein said reflecting plate is made of an opaque material.

9. The illuminated touch keyboard according to claim **1**, wherein said key structure comprises:

a keycap comprising a pressing part and a plunger part;

a light-outputting part for allowing said light beam to be outputted;

a key base for placing said plunger part of said keycap thereon;

a conductive element located at an end of said plunger part, wherein as said key structure is moved toward said non-contact sensor board, said conductive element is sensed by said non-contact sensor board, so that said key signal is generated by said non-contact sensor board, wherein said conductive element is a conductive foam structure or a metallic paint film; and

an elastic element disposed under said plunger part for allowing said keycap to be returned to an original position.

10. The illuminated touch keyboard according to claim **1**, wherein said key structure comprises:

a keycap;

a light-outputting part for allowing said light beam to be outputted;

a scissors-type supporting structure for supporting said keycap;

a conductive element disposed on a bottom surface of said keycap, wherein as said key structure is moved toward said non-contact sensor board, said conductive element is sensed by said non-contact sensor board, so that said key signal is generated by said non-contact sensor board, wherein said conductive element is a conductive foam structure or a metallic paint film; and

an elastic element disposed under said keycap for allowing said keycap to be returned to an original position.

11. The illuminated touch keyboard according to claim **1**, wherein said pin is disposed on said light-shading plate.

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